

MORPHOLOGY AND ANATOMY OF THE INFLORESCENCE AXIS AND FLOWERS OF A NEW PALM, ARISTEYERA SPICATA¹

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A DESCRIPTION OF THE INTERNAL STRUCTURE of the unusual inflorescence and flowers of *Aristeyera spicata* is presented here to accompany the generic description (Moore, 1966) and an account of the vegetative anatomy (Tomlinson, 1966).

In the palms, branching of the major inflorescence axes is monopodial (H. E. Moore, Jr., personal communication), but in the ultimate flowering clusters, several different patterns of branching occur. Flowers have been described as solitary (*Sabal*), in pairs (*Calamus*), in triads (*Aristeyera*), in glomerules (*Livistona chinensis*), in acervulae (*Mascarena*), and in cincinni (*Borassus*). More than half the known genera of palms bear flowers arranged in triads. Work is presently under way on the structure and relationships of these different flowering units.

The anatomy of the Geonomoid palms (Palmae-Arecoideae-Geonomeae) has not been studied previously. In this tribe, 3-flowered clusters (triads) are completely or partially sunken in pits in the inflorescence axes. This paper presents an anatomical analysis of the flowers and of the branching pattern of the triad as found in *Aristeyera spicata*.

MATERIAL AND METHODS

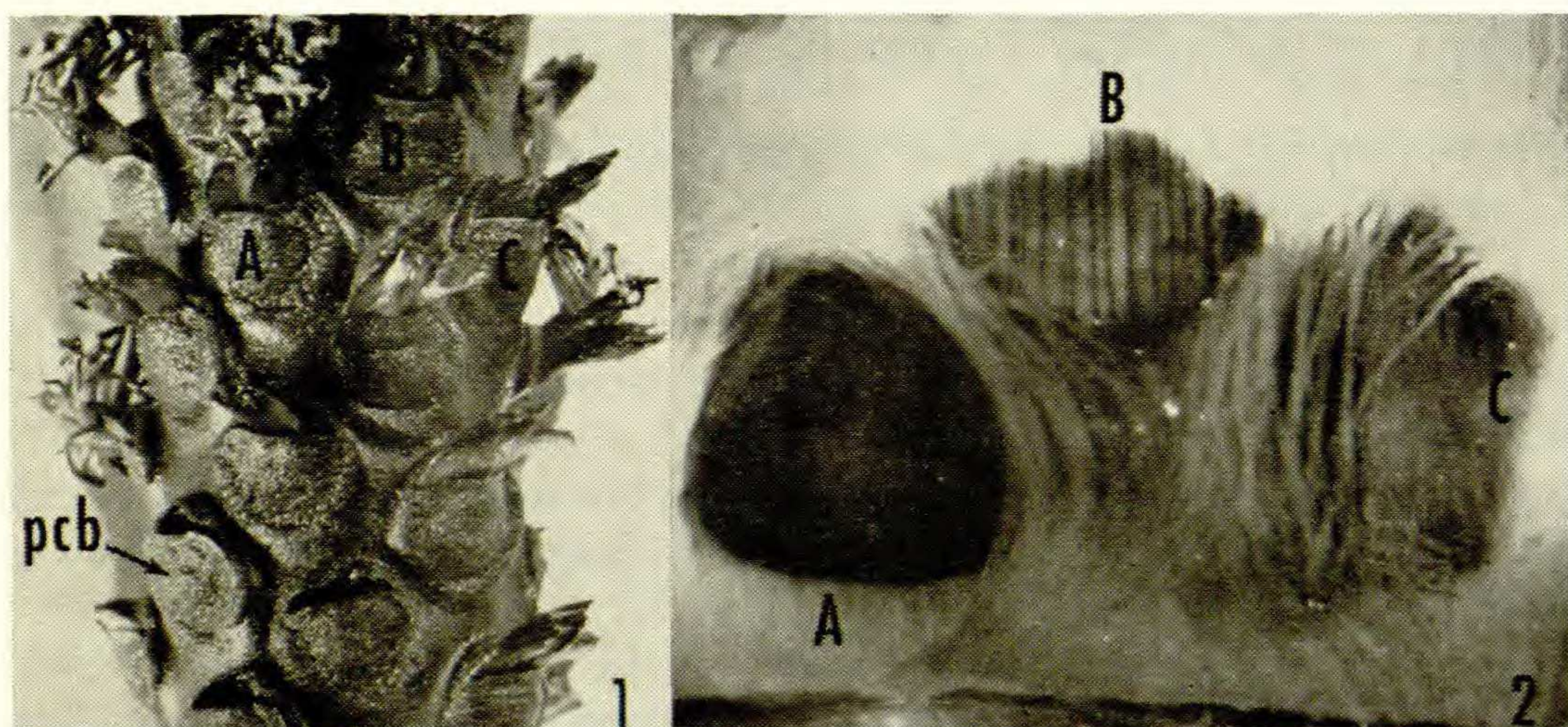
The material studied, which was kindly collected and fixed in FAA by Lic. L. Aristeguieta on December 28, 1962, included inflorescences in bud, at anthesis, and in fruit. Material was softened by treatment for two weeks in one-third strength commercial (52 per cent) hydrofluoric acid. Serial sections of flowers and parts of the inflorescence, prepared by the usual paraffin method, and cut at 10 and 15 microns, were stained with safranin and fast green. Although tannins made complete clearing difficult, some flowers and portions of axes were cleared satisfactorily by treatment overnight in 5 per cent sodium hydroxide in an oven at 59° C., followed by two to four hours in one-third strength commercial sodium hypochlorite, and approximately 12 hours in a saturated solution of chloral hydrate.

INFLORESCENCE AXIS

The spicate inflorescence axis of *Aristeyera* (FIG. 1) consists of eight vertical rows of pits, each pit containing a cluster of three flowers (a

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triad), and closed completely in bud by an obovate bract. In FIGURES 3 and 4, the letters A-H indicate successively higher pits in the phyllotactic succession (usually corresponding in mid-axis to an irregular $3/8$ phyllotaxy) of a young inflorescence axis with buds. Below each pit, the



FIGS. 1 and 2. *Aristeyera spicata*. FIG. 1. Part of a spike with staminate flowers at anthesis; pcb, pit-closing bract, $\times 2$. FIG. 2. Cleared preparation showing three pits: A, B, and C. Refer to pits A, B, and C in FIG. 1 for orientation, $\times 8$.

vascular strands to each triad (at the level A in FIGS. 3 and 4) are arranged in a single group. Slightly higher (represented by the vascular plexus at B), these bundles are divided into two groups. In the pit at C, the section passes through a pit cavity containing flower bases and bracteoles. A pit including flowers and bracteoles at a slightly higher level is cut at D. The four pits, E, F, G, and H are sectioned above the flowers, at successively higher levels.

Enclosed in each pit are two lateral staminate flowers (FIGS. 3 and 4, fs and ss), an inner central pistillate flower (pf), and three bracteoles (FIGS. 3 and 4, ob, mb, ib). Flower clusters may be designated as left-handed or right-handed depending on whether the first staminate flower (FIGS. 3, 4, and 9, fs), borne outside all bracteoles, is on the left or right side of the triad. Left-handed and right-handed triads are mirror images of each other and generally alternate in spiral succession.

The sequence of the floral axes in a pit may be deduced from the position of the three bracteoles associated with the flowers. It appears that the initial axis (FIG. 10, broken line) of the 3-flowered group arises in the axil of the bract that covers the pit (pcb, FIGS. 1, 3, 4, and 9). This axis bears the outer (FIG. 10, ob) bracteole of the triad and terminates with the first staminate flower (FIG. 10, fs). Arising in the axil of the outer bracteole (FIG. 10, ob) is a secondary axis that bears the bicarinate middle bracteole (FIG. 10, mb) and ends with the second staminate flower (FIG. 10, ss). A third-order branch arises in the axil of the bicarinate bracteole (FIG. 10, mb), bears the uppermost (inner) bracteole (FIG. 10, ib), and

ends with the pistillate flower. No vascular bundles are present in any of the three bracteoles, but each has an adaxial row of fibrous bundles having no connection with any other veins. The branching pattern of the triad here corresponds to that of a monochasium, as defined by Rickett (1955, p. 444).

Thus, on the basis of general form and the pattern of bracteoles and flowers in each pit, the inflorescence of *Aristeyera* is interpreted as an indeterminate main axis bearing eight rows of determinate 3-flowered units (FIG. 10), each unit enclosed in a pit sunken in the main axis and covered by a subtending bract.

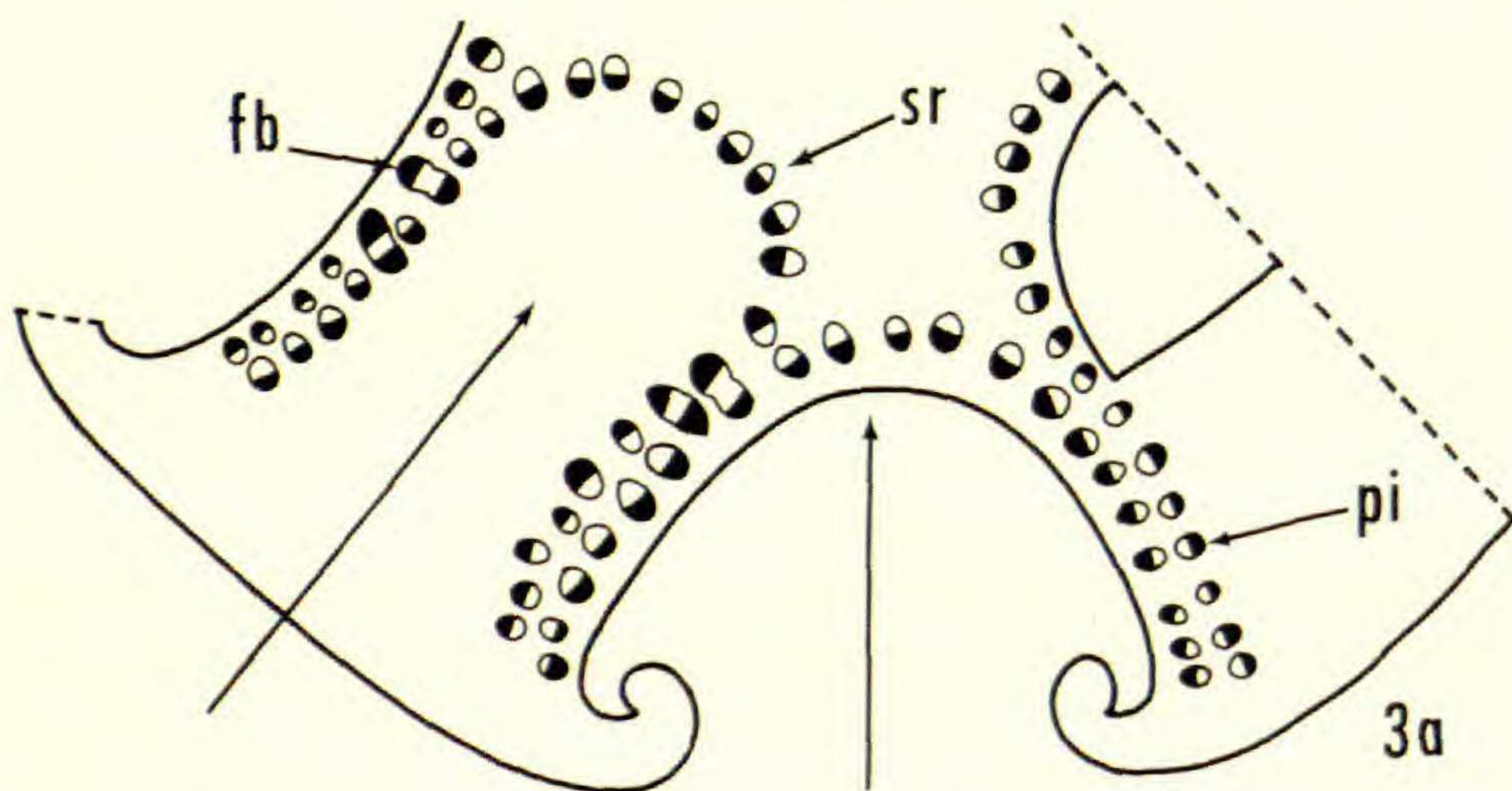
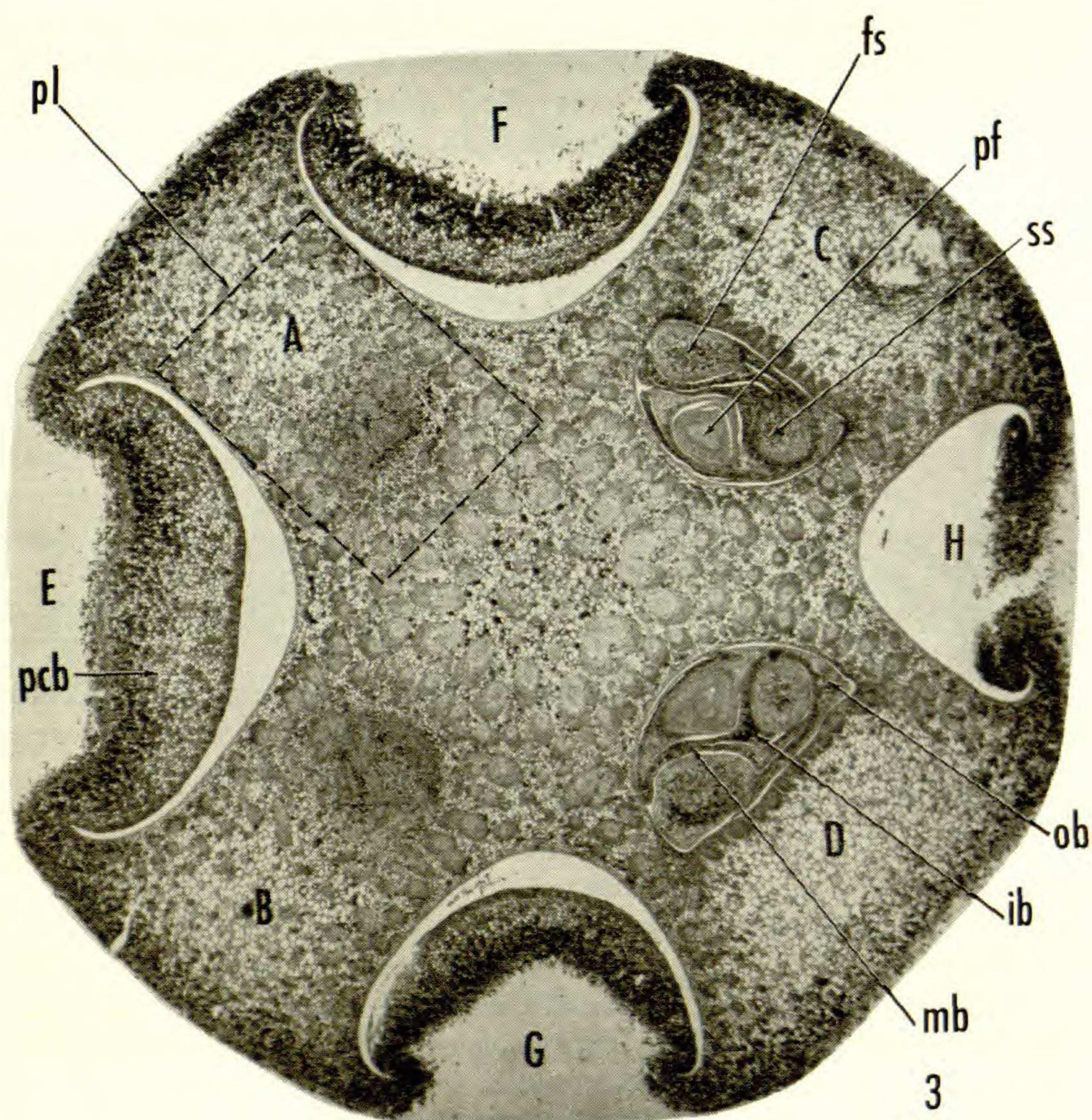
Histological features. The inflorescence axis is densely covered with profusely branched, dendroid trichomes containing tannin and originating from columnar epidermal cells. The hypodermis is a single layer of short, isodiametric cells. In the periphery of the inflorescence axis, just inside the hypodermis, many small (5 to 10 cells in transection) bundles of fibers form an anastomosing system.

The large bundles of the axis are arranged in a low spiral and oriented with the xylem toward the center of the axis. They gradually decrease in size from the largest, which occur in the second row inside the pits, to a few small vascular or entirely fibrous strands in the center. The xylem of the large vascular bundles consists of two large vessels and several smaller elements. Xylem and phloem meet in a straight line (type 3A, Cheadle and Uhl, 1948). The large vessels, often immature even in old axes, have long oblique, compound perforation plates with many (40 to 50) scalariform bars. Smaller xylem elements are helically thickened. A fibrous sheath, generally two cells in width, but sometimes wider (3–4 cells) around the phloem, surrounds each bundle. Two adjacent phloem areas in the same bundle occur below a bundle branch.

Pits. Each cluster of three flowers and the associated bracteoles are deeply sunken in a pit. Around the inner edge of each pit is a single row of bundles (FIG. 3a, sr). Bundles in the centripetal part of this row are oriented as are the central bundles of the axis, with the xylem toward the center, but between adjacent pits (FIG. 3a, pi), the bundles appear partially inverted with reference to the center of the axis. This orientation of axis-bundles adjacent to the pits indicates that pits represent depressions or invaginations in the surface of the axis (FIG. 3a, arrows).

Where vascular bundles between adjacent pit cavities (FIG. 3a) are crowded together, back to back, fusion sometimes occurs between the xylem (FIG. 3a, fb) of bundles extending around the edge of one pit and the corresponding row around the adjacent pit. The xylem of these fusion bundles is large, sometimes two-lobed, and between two opposite phloem groups. Distally, where the pit cavities are smaller in size and the vascular strands are less crowded, the bundles are usually separate.

Each pit is covered by a bract with a fleshy, tapering proximal half which is completely embedded in the axis (FIG. 4, stippled areas, A, B,



FIGS. 3, 3a. *Aristeyera spicata*. FIG. 3. Transection of a young spike. Phyllocladus succession indicated by letters: A, B, C, D, E, F, G, and H. Centripetal to A and B are vascular complexes below pits. Pits at C and D show flower bases and bracteoles. Pits E, F, G, and H sectioned above flowers. Details: pcb, pit-closing bract; fs, first staminate flower; pf, pistillate flower; ss, second staminate flower; ob, outer bracteole; mb, middle bracteole; ib, inner bracteole;

C, D). Distally, where the bract is free, the edge of the axis (FIG. 3, G) is involute and the upper edge of the bract is revolute. When the inflorescence is in bud, the inrolled edges of the axis "lock" the bract into position

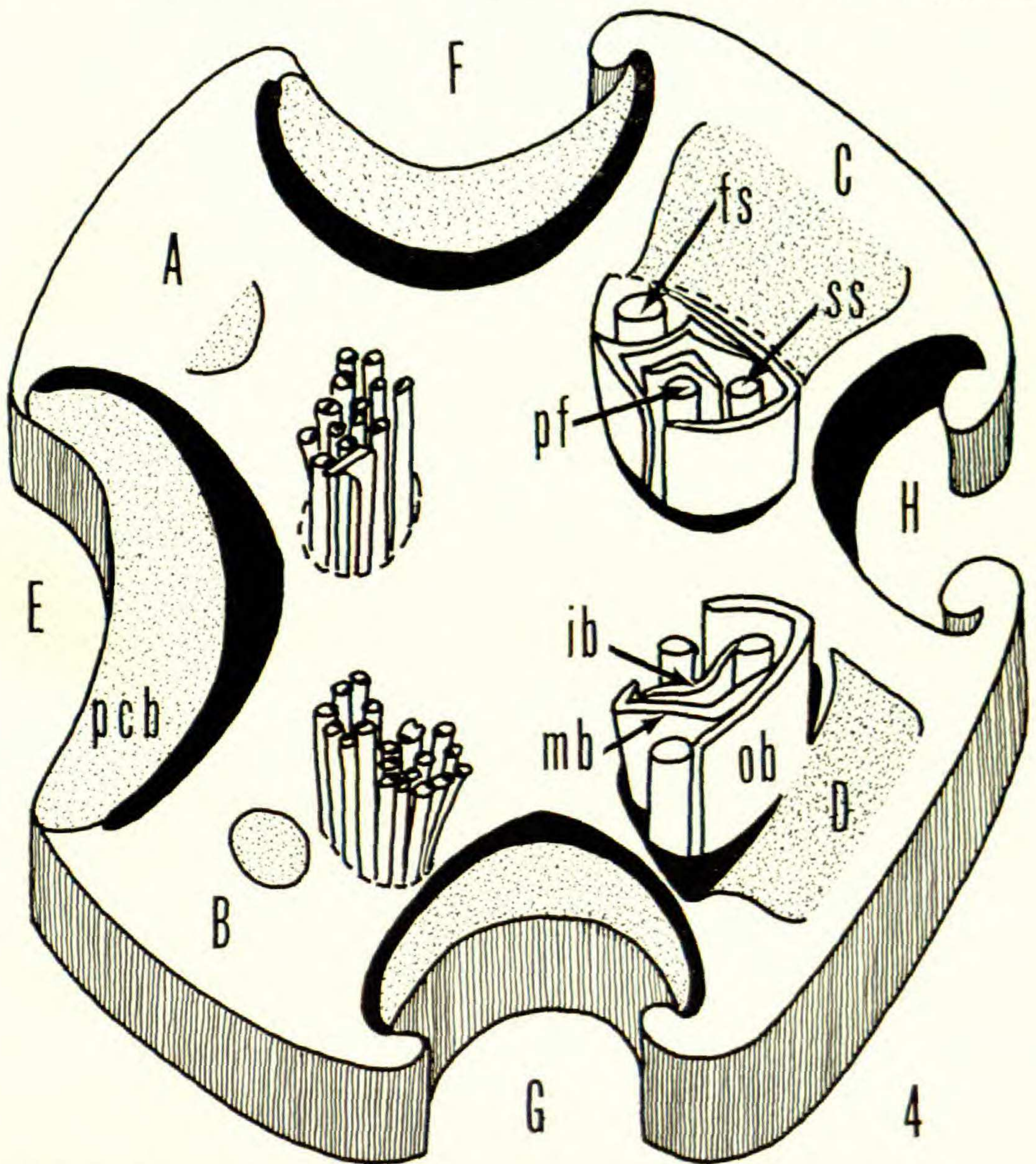


FIG. 4. *Aristeyera spicata*. Three-dimensional diagram of transection of young spike illustrating structures seen in FIG. 3. Vascular bundles seen in FIG. 3a not represented. [Traced from material represented in FIG. 3 and a section 60 microns lower.]

over the pit. Later, when the upper half of the bract becomes disengaged, the flowers are exerted through a mouth-like opening (FIG. 1). In fruit the bract is pushed farther away making a larger opening. These observa-

pl, approximate position of polarized light pictures (FIGS. 5-8), $\times 12$. FIG. 3a. Diagram of lower part of transection (FIG. 3) to show orientation of bundles around pits. Details: sr, single row of bundles around contour of a pit; pi, partially inverted bundle; fb, fusion bundle; phloem, black; xylem, white. Unlabeled arrows indicate the direction of invagination of the axis.

tions also support the conclusion that the pit represents an invagination of the surface of the axis.

Subtending bract. The limits of the obovate bract covering each pit are easily recognized histologically. Except for an adaxial row of parallel vascular bundles (FIG. 2, B) the bract is composed entirely of parenchyma cells that are somewhat larger than those of the axis proper (FIG. 3, D).

In cleared preparations, it is possible to remove the epidermal and outer fibrous systems of the axis and the thick outer parenchymatic part of the bract and thereby reveal the longitudinal shape of the bract and the vascular skeletons of bract and axis. A group of three pits (FIG. 2, A, B, and C, corresponding to pits A, B, and C in FIG. 1) were prepared in this manner. The bract bundles, shown in transverse section, abaxial to the pits at C and D in FIG. 3, are shown in longitudinal view below B in FIGURE 2. These traces originate from bundles of the main axis, usually as branches of the row of strands (FIG. 3a, sr) that, at a lower level, curve around the pit cavity beneath. Near the tapered base of the bract, some of these veins may enter the bract directly, or they may divide to form an inner branch to a floral axis and an outer branch to the bract. The shape and extent of the lower part of the bract can be further verified by comparing the longitudinal view (FIG. 2, B) with different levels of the bract as seen in transverse section (FIG. 4, stippled areas). In FIGURE 3, the letters A and B are in the approximate centers of small areas of large parenchyma cells representing transverse sections of the lower, tapered bases of the bracts. Slightly higher, the bracts are larger (FIG. 4, C and D, stippled areas).

Vascular patterns below pits. The configuration of bundles below the three flowers in a pit is illustrated by photomicrographs taken in polarized light (FIGS. 5–8) in which the early metaxylem is anisotropic and appears as bright spots. The relative size and position of the areas in these pictures is indicated by the broken lines in FIGURE 3, pl. The fibrous sheaths of the bundles in this young axis were not mature and did not exhibit birefringence.

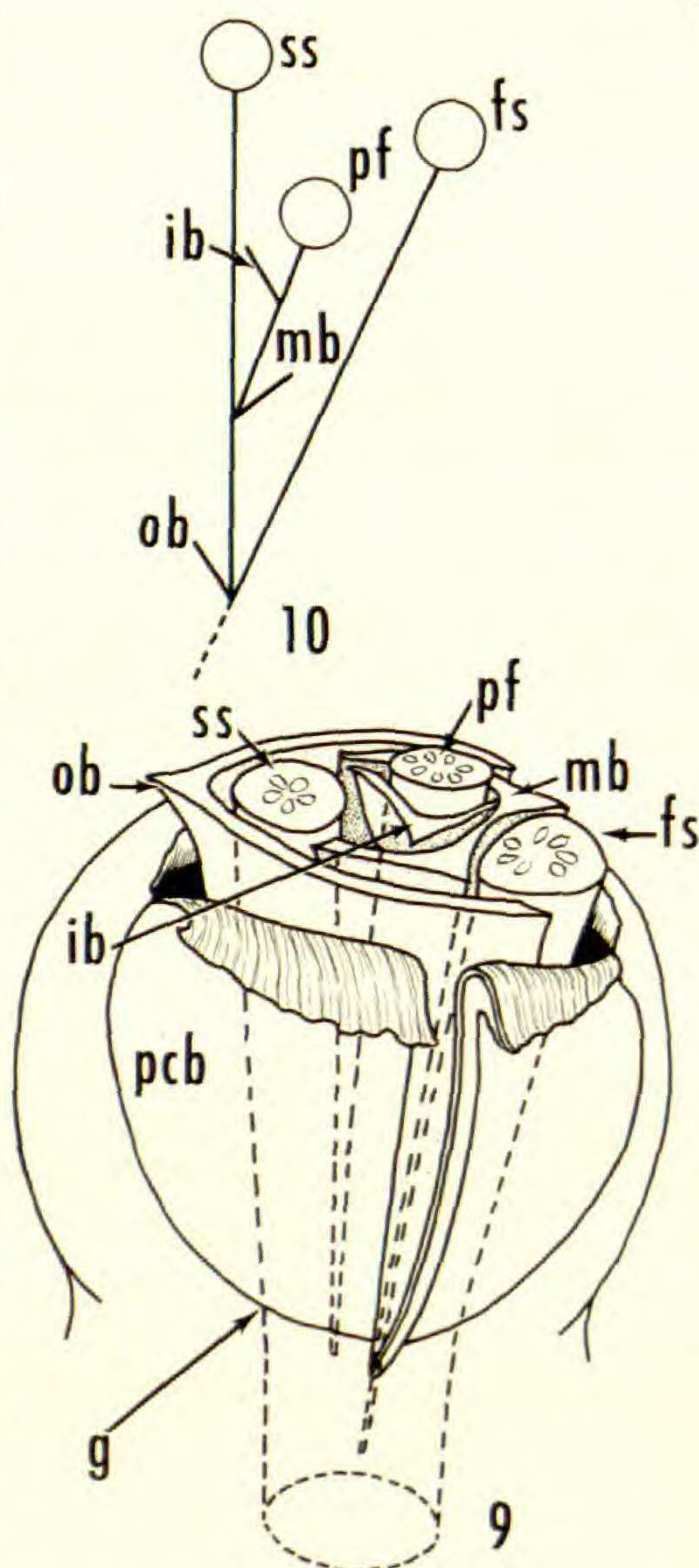
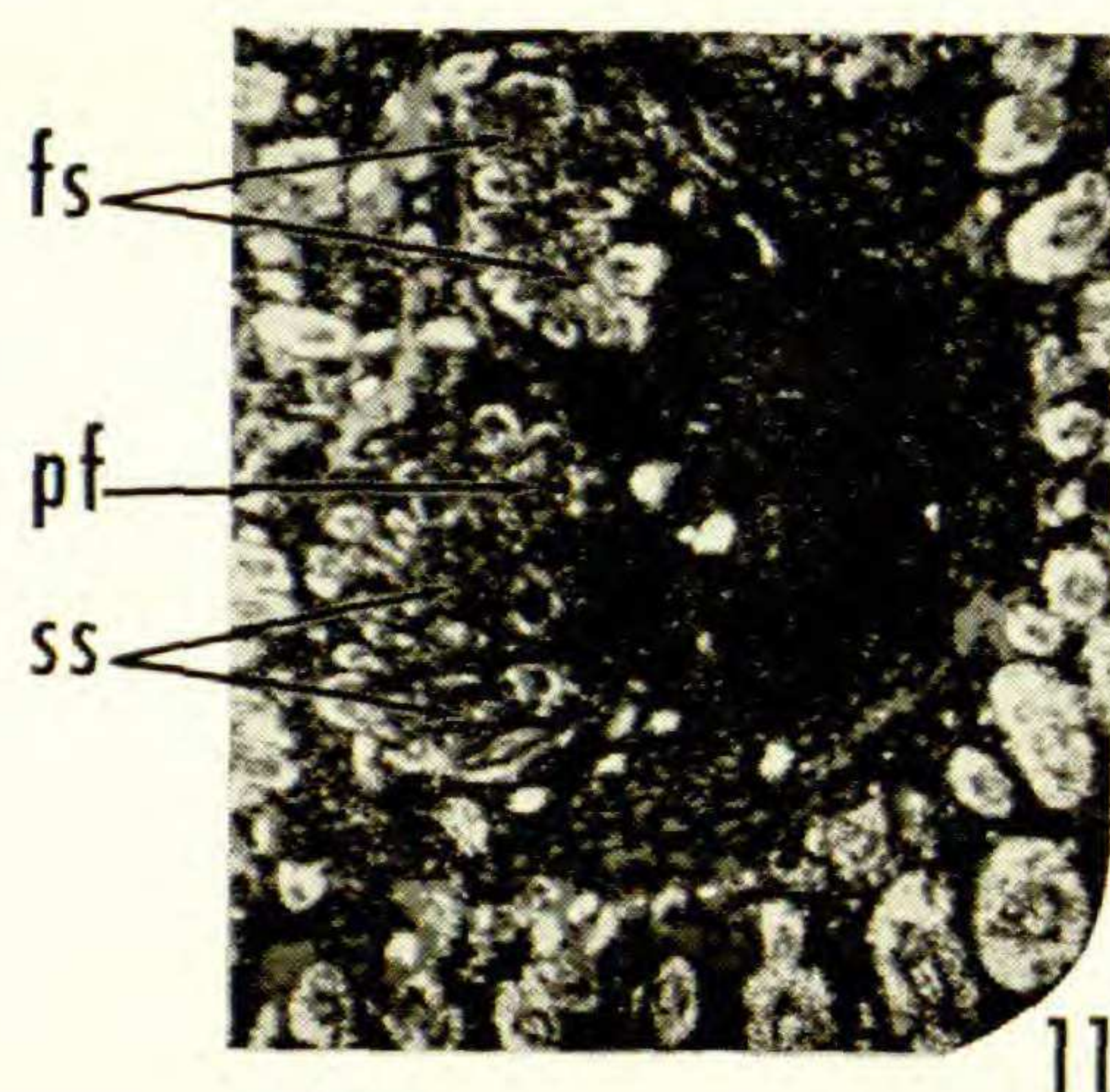
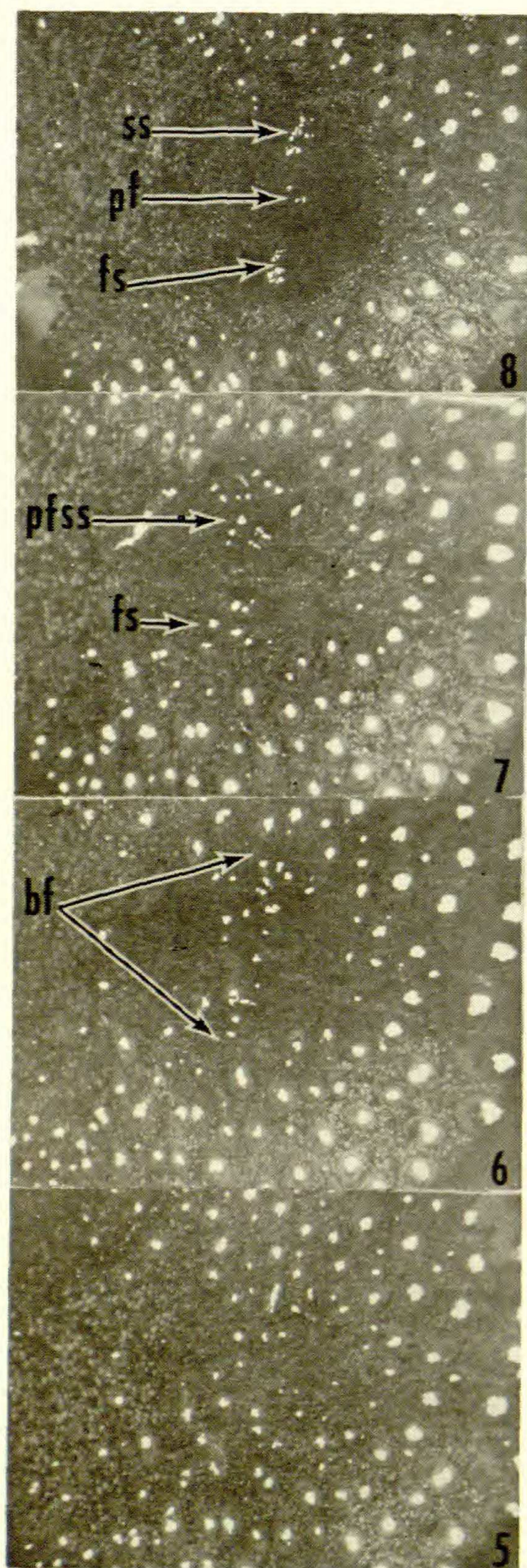
The first evidence of a pit appears as a bundle-free central area with small peripheral bundles (FIG. 5), approximately two-thirds to three-fourths the vertical distance above the top of the pit below. These small bundles originate as centripetal branches of the single row of strands around the pit. Slightly above the level in FIGURE 5, those small bundles which at a higher level supply the pit triad are arranged in an oblong group (FIG. 6, bf). This group of bundles divides into a larger (FIG. 7, pfss) and a smaller cluster of strands (FIG. 7, fs). The veins of these two groups become oriented so that the xylem of each bundle faces the center of each group. The smaller cluster supplies the first staminate flower (FIGS. 7–10, fs). At a higher level (FIG. 8), the second and larger group of bundles divides again to form two groups, the inner (pf) supplying the pistillate flower and the outer the second staminate flower (ss).

Thus anatomy confirms an arrangement of the flowers in the triad which was suggested by the position of the bracteoles (FIGS. 9 and 10). The group of irregularly arranged bundles (FIG. 6, bf) represents the base of the branch subtended by the pit-closing bract and is shown as a dotted line in FIGURE 10. This group of bundles divides (FIG. 7 and FIG. 10, level ob), forming the vascular cylinder of a submerged branch on which the first staminate flower is terminal and a second branch which is represented by the vascular bundles in FIGURE 7, pfss. The second branch terminates in the second staminate flower (ss) and bears a lateral branch (the cluster of bundles, FIG. 8, pf) terminating in the pistillate flower.

Detailed study of the vascular bundles shows evidence of additional branching. The vascular supply below the first staminate flower always divides to form two, usually unequal, groups of bundles (FIGS. 8 and 11, fs), each oriented with the xylem toward its center. In a mature axis, two vascular cylinders of approximately 9 bundles each can be seen surrounding the ends of the arrows (FIG. 11, fs). The same may also occur below the second staminate flower (FIG. 11, ss). The supply to the pistillate flower is often separated into two groups without forming two completely reoriented circles of vascular bundles. Each of the two groups of bundles at this level resembles the vascular supply that eventually enters the receptacle of the individual flower, but above this level, some (2-4) of the bundles fuse, others (1-4) end blindly and the two vascular cylinders become reoriented into one. The new cylinder is composed of ten to twelve vascular bundles just below the insertion of the perianth parts of each flower. This abortive branching of the vascular supply below a flower is evidence that, ancestrally, additional flowers may have been present in each triad. In *Aristeyera* this unit seem to have originated from a more ramified type of inflorescence.

FLOWERS

In the following sections certain structural aspects common to both staminate and pistillate flowers are first discussed briefly and then details peculiar to each are described. Vascular bundles in the flowers are very small, the xylem containing no large vessels and consisting of a few helical elements. The number of traces to perianth parts is variable. Two other features are worthy of note: (1) in the petal tube of the staminate flowers and in the sepals of pistillate flowers, some of the traces appear to differentiate over a long period of time and as a result the number of traces increases with the age of the flower; (2) the traces developing later do not become connected to the vascular strands in the floral receptacles. Unconnected lateral traces have also been found in perianth parts of *Borassus* (unpublished) and in *Chamaerops* (Morrow, 1965). There is evidence in monocotyledons that the procambium of lateral leaf traces develops basipetally (Sharman, 1942). In certain palms this is also true for some lateral bundles of sepals and petals.



FIGS. 5-11. *Aristeyera spicata*. FIGS. 5-8. Serial transections of a part (FIG. 3, pl) of the axis below a pit, taken in polarized light; bright spots are the early metaxylem; the late metaxylem and fibrous sheaths are immature and do not polarize. Center of the main axis is to the right, outer edge to left, all $\times 25$. FIG. 5. Approximately 720 microns above the pit below. FIG. 6. 170 microns above FIG. 5; bf, bundles which, at a higher level, supply the three flowers in the

Staminate flowers. In staminate flowers the stalk has a wide parenchymatic cortex and a small central vascular cylinder of a varying number of bundles (5, 6, 7, and 11, observed). Traces of all floral organs arise in a spiral pattern as branches of these few receptacular bundles (FIG. 18). The stalk elongates until at anthesis the upper one-third of the flower with its exerted stamens is pushed out between the pit-closing bract and the axis (FIG. 1). Anthesis of both staminate flowers occurs before the pistillate flower in the same pit is receptive; as the pistillate flower matures, the staminate flowers wither in the pit or are shed by rupture of the stalks.

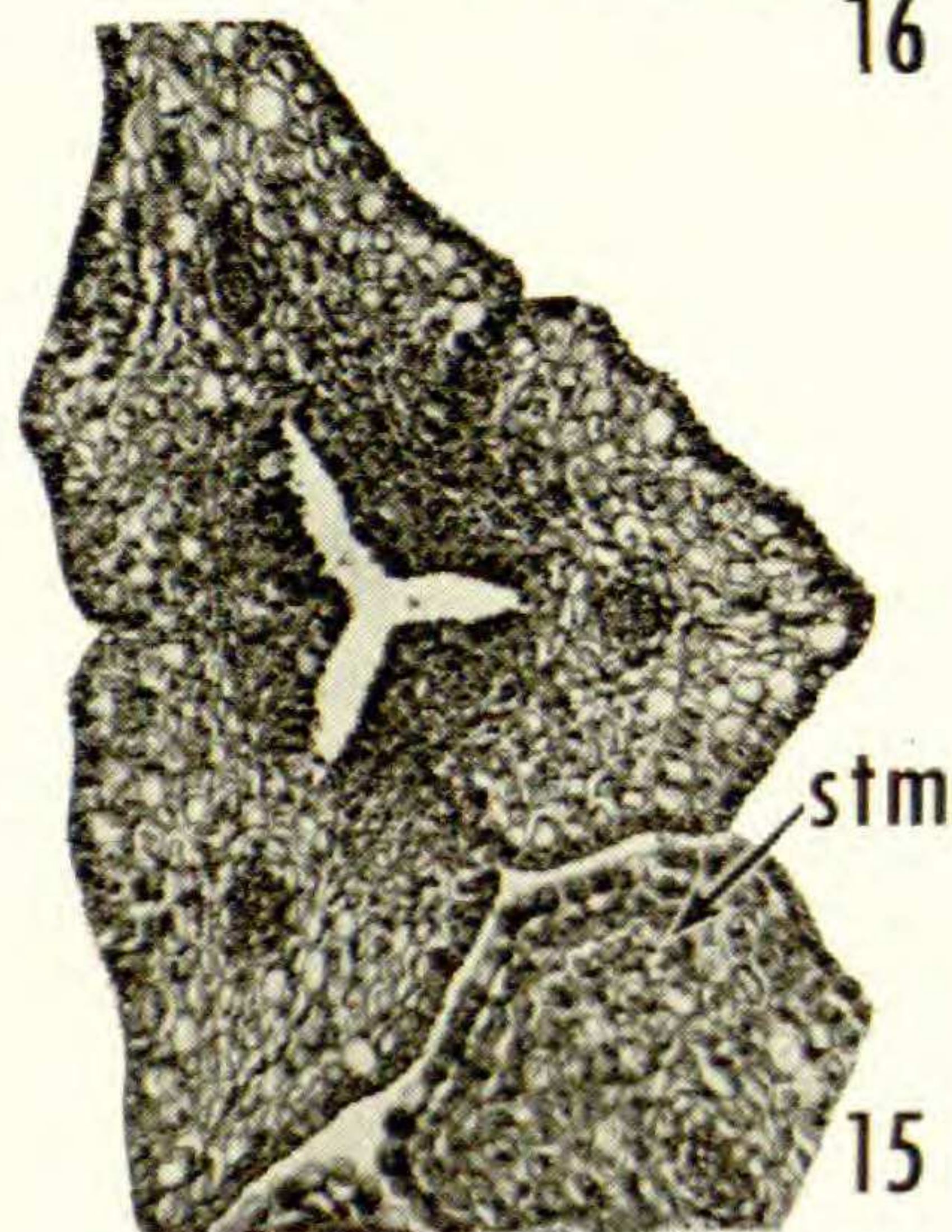
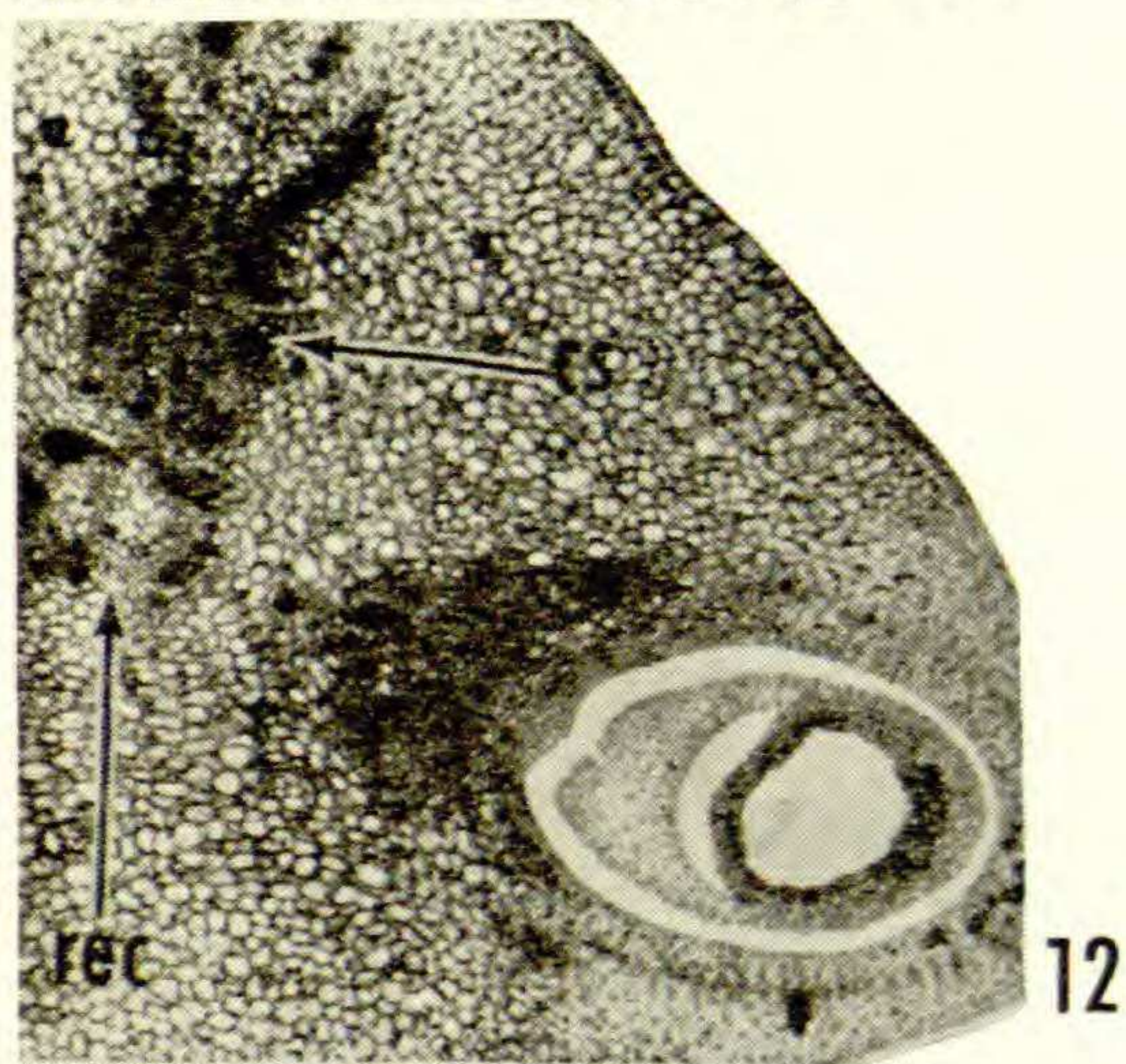
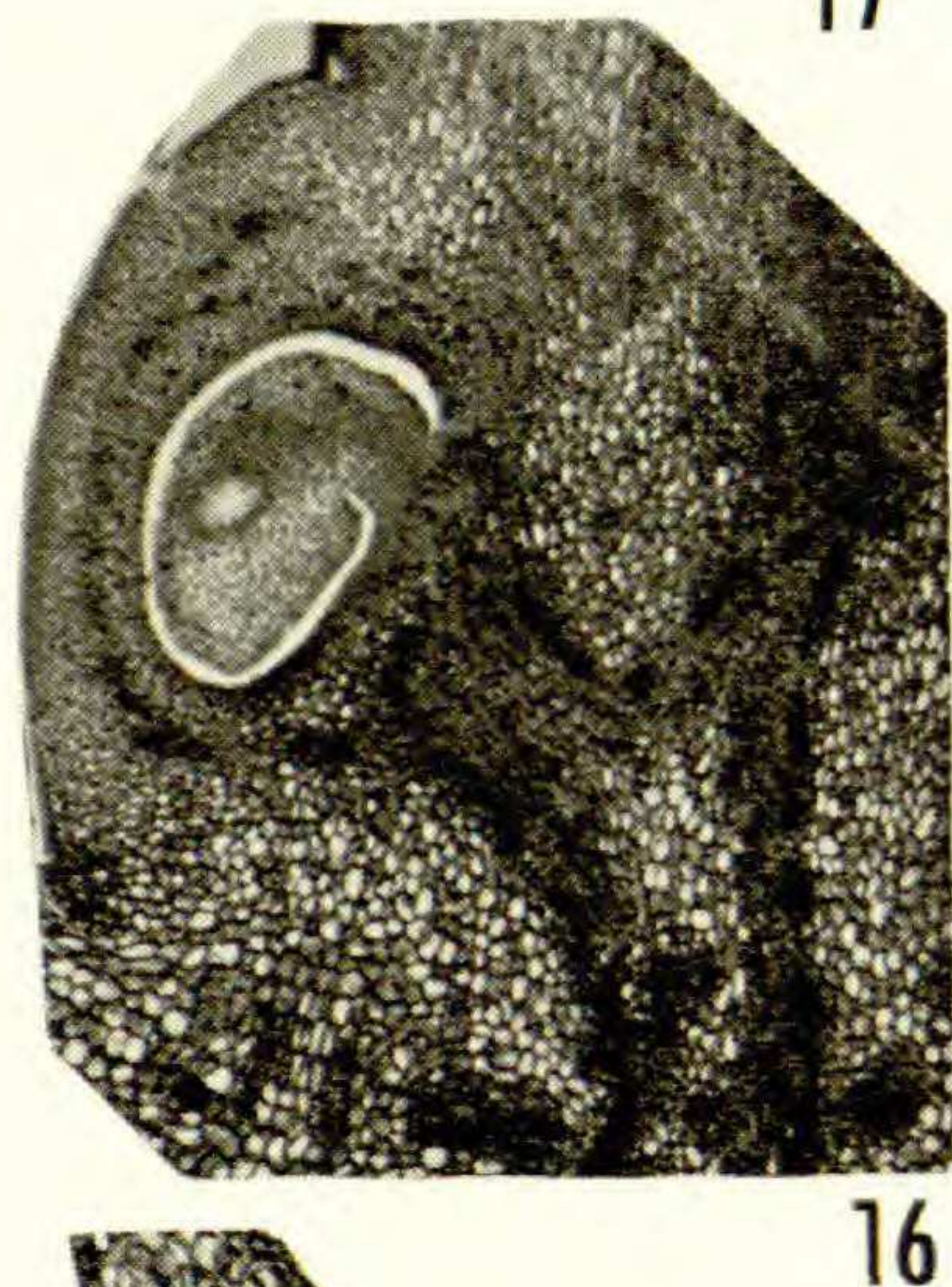
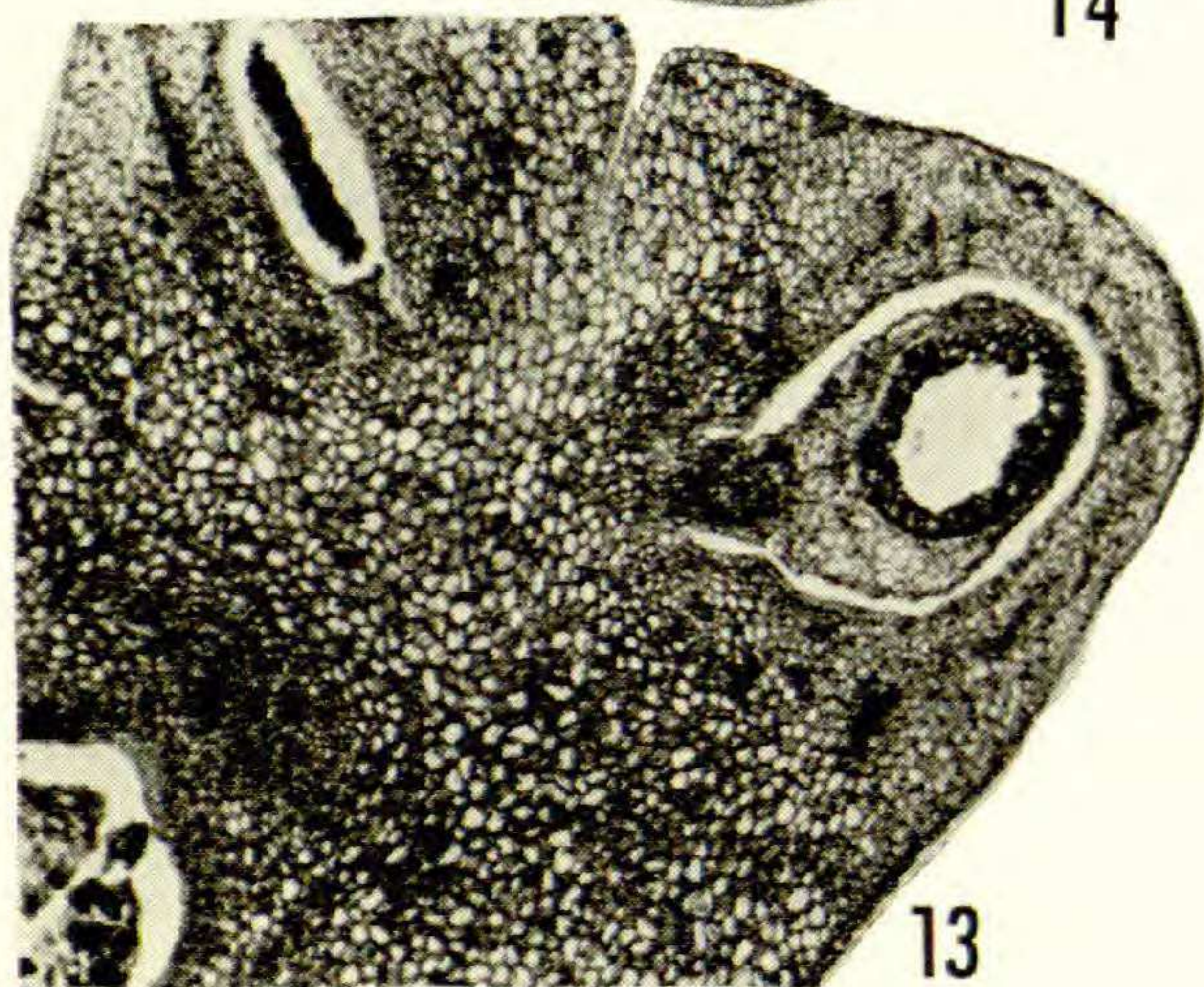
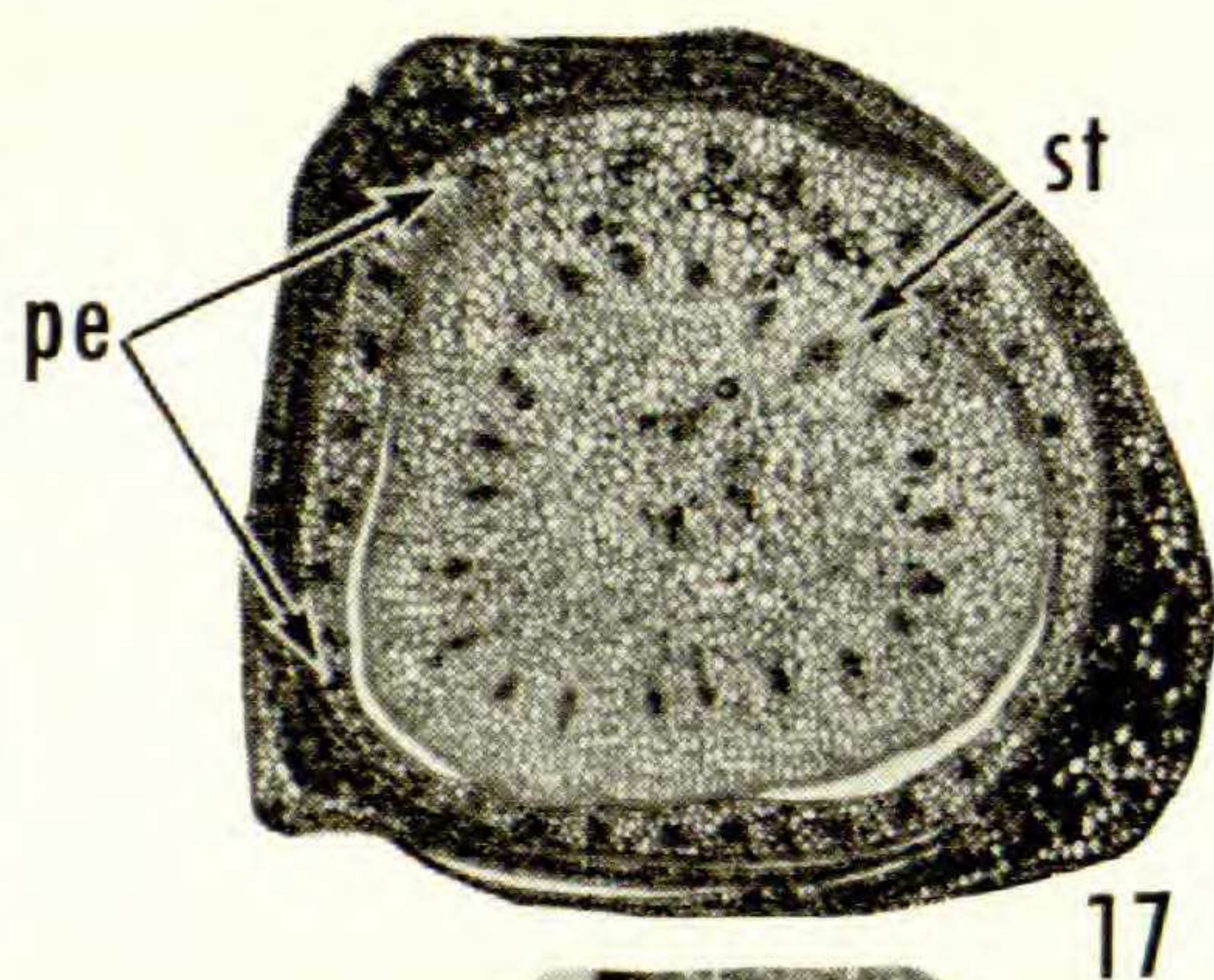
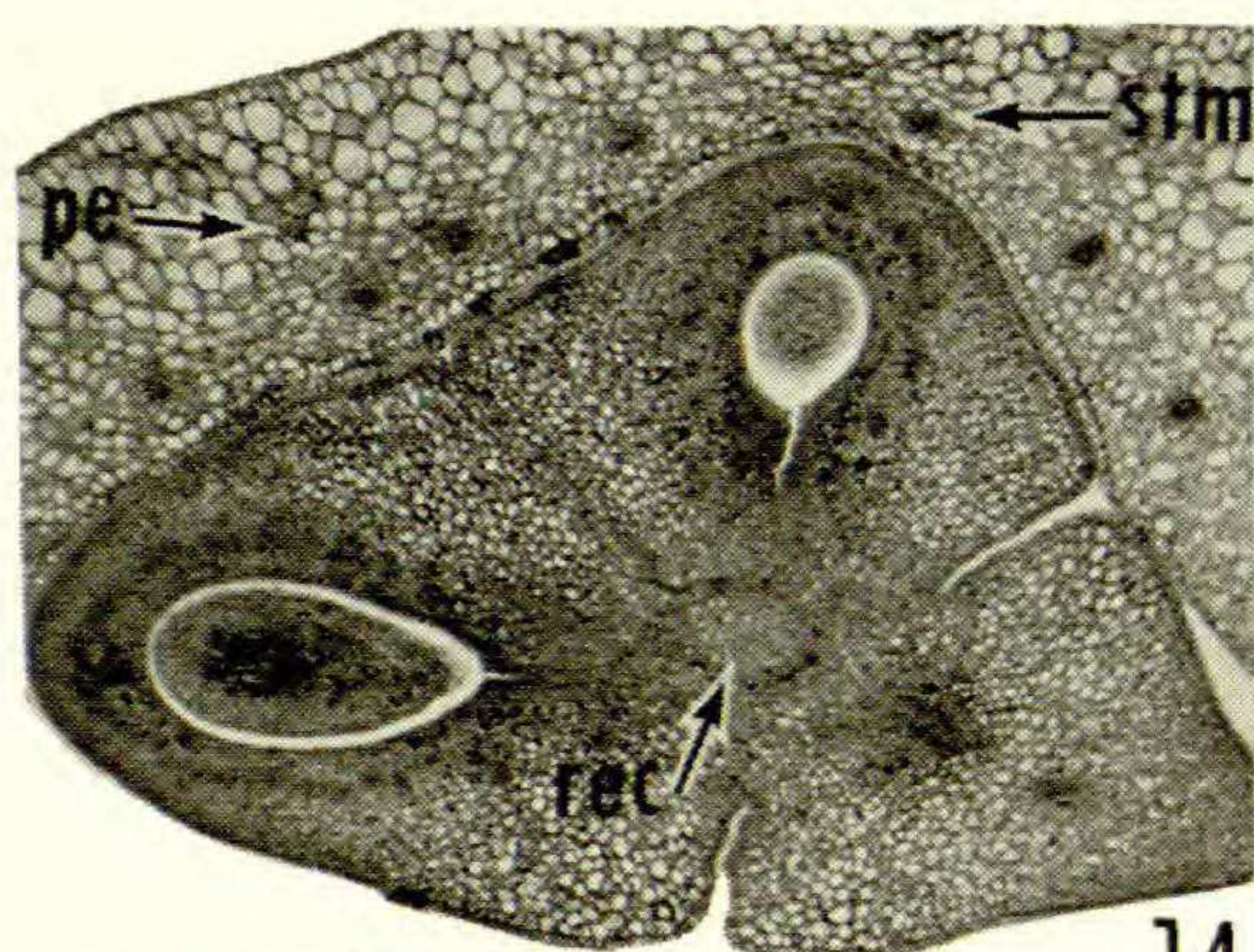
The sepals are attached spirally, their few vascular bundles arising as branches from receptacular bundles opposite their bases (FIG. 18, S1, S2, S3). In each flower, the sepals are imbricate and progressively smaller. Corresponding to this sequence, the lowest sepal receives three, four, or five vascular traces and the second and third sepals, one, two, or three traces. In the adaxial row in each sepal most of the bundles are fibrous strands which alternate with the few vascular bundles (above), and extend from the sepal bases nearly to the tips, but these do not extend into the stalk nor have any connection with bundles of the floral receptacle.

The petals of staminate flowers are connate for about one-third to three-fourths their length; above this they are imbricate for a short distance, then becoming valvate. Traces to the corolla arise from receptacular bundles in three successively higher groups (FIG. 18, p1, p2, p3; FIG. 17, pe), indicating a spiral arrangement of the petals. Some of the vascular bundles differentiate basipetally and are not connected to the floral receptacle. In the upper three-fourths of the petals many unconnected fibrous strands occur in the adaxial row of bundles.

The morphology of the 21 to 24 stamens is unusual (Moore, 1966); the anatomy, however, is straightforward. Bundles of the receptacle branch above the origin of the petal traces in a flat and irregular spiral pattern to form a single trace to each stamen. In FIGURE 17, traces to 23 stamens (st) surround the remaining three bundles of the floral receptacle (center).

The pistillode resembles the gynoecium of the pistillate flowers, consisting of a central axis with three rudimentary carpels. Bundles (3, 4, or

pit. FIG. 7. 120 microns above FIG. 6; fs, supply to the first staminate flower; pfss, supply to the second staminate flower and the pistillate flower. FIG. 8. 320 microns above FIG. 7; fs, supply to the first staminate flower, divided into two groups at this level; pf, supply to the pistillate flower; ss, supply to the second staminate flower. FIG. 9. Diagrammatic drawing of a pit. Details: g, flower bases and bracts occur at approximately this level but are extended to facilitate showing bracteoles; pcb, pit-closing bract; ob, outer bracteole; mb, middle bicarinate bracteole; ib, inner bracteole; fs, branch bearing first staminate flower; ss, branch bearing second staminate flower; pf, branch bearing pistillate flower. FIG. 10. Diagram showing relation of branches, flowers, and bracteoles *within* a pit. For details see legend, FIG. 9. FIG. 11. Transection of same area as FIGS. 5-8 (FIG. 3, pl) but of an older axis. Details: fs, ends of arrows indicate two vascular cylinders below the first staminate flower; ss, two vascular cylinders below the second staminate flower; pf, group of bundles which supply the pistillate flower, $\times 20$.



FIGS. 12-17. *Aristeyera spicata*. FIG. 12. Transection of part of the ovary showing the locule of one carpel with ovule; rec, floral receptacle above separation of the traces to all three carpels; cs, lateral traces to uppermost carpel, $\times 61$. FIG. 13. Transection of parts of the three carpels at the level of attachment of the ovule in the middle carpel, $\times 61$. Observe the difference in the length of the slits beside the funiculus. FIG. 14. Transection of part of the pistillate flower including the ovary and a portion of the corolla-staminode tube; pe, petal trace; stm, trace to a staminode, $\times 40$. FIG. 15. Transection of the style and part, stm, of one staminode, $\times 78$. FIG. 16. Longitudinal section through one carpel showing the pendulous ovule, $\times 44$. FIG. 17. Transection of a staminate flower; pe, arrows indicate one group of petal traces; st, stamen trace, $\times 44$.

7 observed) remaining above the stamen traces (center bundles, FIG. 17) supply the pistillode. In one flower, the seven traces to the pistillode formed three groups and the xylem of each group coalesced, resembling the pattern found in the supply to the carpels of pistillate flower. Usually a single trace, sometimes formed by fusion of two or more receptacular strands, supplies each vestigial carpel.

Pistillate flowers. In bud, the pistillate flower, situated below and adaxial to the male flowers, is attached by a short, thick base which extends adaxially between the stalks of the staminate flowers to the inner central region of the pit. The vascular supply of the axis bearing the pistillate flower usually consists of a cluster of ten to 12 bundles. Several (2-4) of these fuse or end blindly and the remaining extend into the flower (FIG. 19).

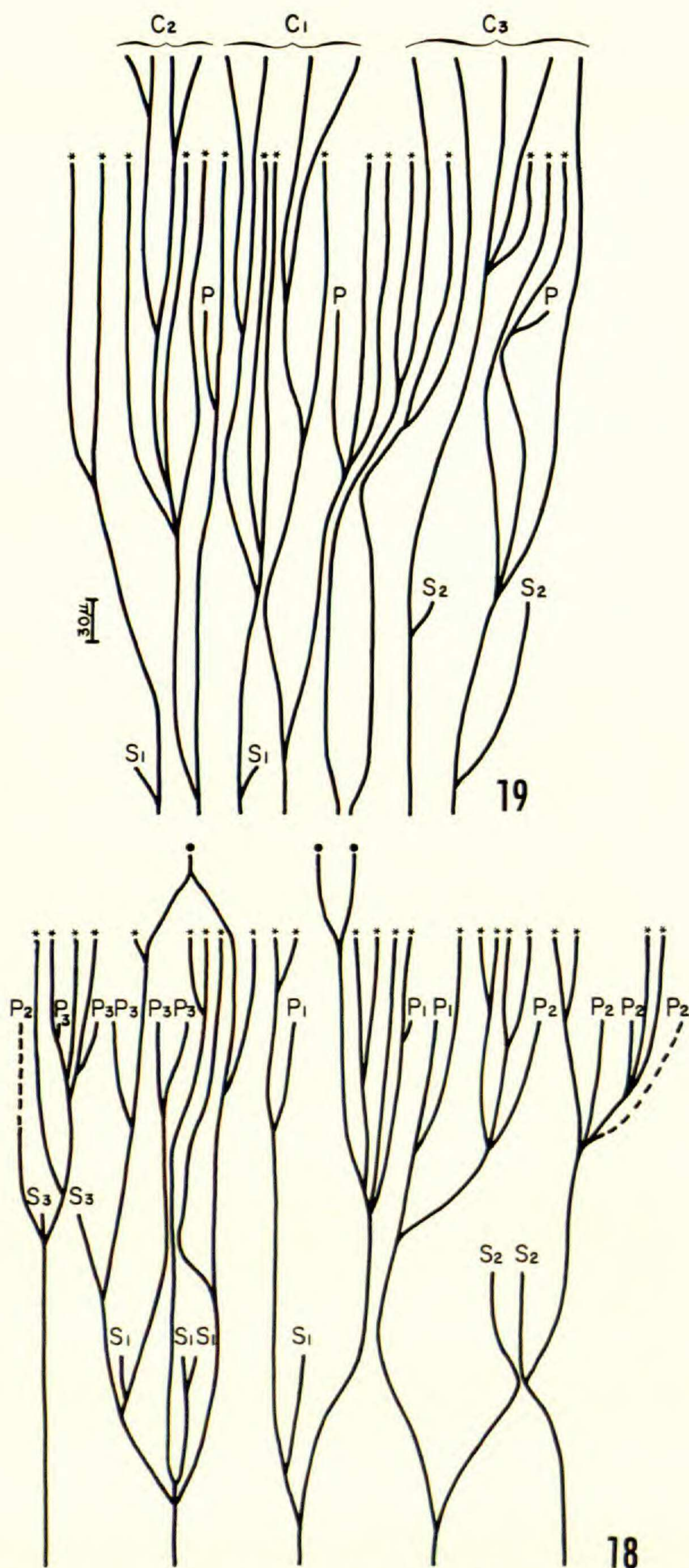
Vascular traces to the sepals are somewhat fewer than in the staminate flowers; two or three strands to the first sepal, two to the second, and one or none to the third were observed (FIG. 18, S1, S2). As in the staminate flowers, each sepal is successively smaller and the few vascular traces alternate with unconnected fibrous strands in an adaxial row of bundles.

The petals are connate for about two-thirds their length, then briefly imbricate, and the free tips valvate. The corolla tube is supplied by three very small traces (FIG. 19, P; FIG. 14, pe). These are the smallest bundles in the flowers and consist of one or two xylem elements and one or two sieve elements. In the upper valvate region of the petals are many unconnected fibrous bundles.

The 15 or 16 staminodes (FIGS. 14 and 15, stm) are adnate to the connate petals for about one-fourth the length of the corolla tube. Each receives one small bundle, that arises as a branch of a receptacular strand (FIG. 19) and ends between the vestigial anther sacs. Occasionally a trace to one staminode branches to provide the bundle to an adjacent one.

The floral axis extends approximately to the top of the locule of the highest carpel (FIG. 14, rec). This extension of the floral receptacle above the origin of all carpel traces is evident in the group of small bundles remaining in the center (FIG. 12, rec) and, at a higher level, as a parenchymatic tip (FIG. 14, rec). The gynoecium (Moore, 1966, *Fig. 1, q*) is composed of three carpels that are spirally arranged and closed basally, where they are adnate to the central axis. Near the upper end of the central axis (FIG. 14), the three carpels become free from each other and from the axis. Above the attachments of the ovule, the ventral sutures of each carpel are open; epidermal cells can be seen between individual ventral carpel sutures (FIG. 14). In the long stylar region (Moore, 1966, *Fig. 1, q*), the carpels are open and the degree of connation varies. At some levels glandular epidermal cells extend part way between adjacent carpels (FIG. 15).

Above the origin of the traces to the staminodes, the floral receptacle consists of a ring of eight to 13 bundles (FIG. 19). Just below the ovary, these bundles separate into three groups and the xylem of the bundles in



FIGS. 18 and 19. *Aristeyera spicata*. FIG. 18. Diagram of the origin of floral traces in a young staminate flower. Details: S₁, traces to lowest sepal; S₂, traces to second sepal; S₃, traces to highest sepal. P₁, P₂, and P₃, groups of successive petal traces. Asterisks, stamen traces; black circles, traces to the pistillode.

each group is united, forming a fusion bundle with one large central xylem area and three to five outer patches of phloem. The central part of each of these compound bundles extends radially across the syncarpous base of the ovary and becomes a dorsal carpel bundle which curves upward around the locule and divides tangentially at the base of the long style. One of the branches crosses the top of the locule for a very short distance, the other extends through the style to the stigmatic lobe. At the base of each carpel, some 20 lateral bundles diverge from the two opposite sides of the fusion bundle and form a complete ring of bundles which extend around each locule. Two of these lateral traces extend into the style. Several (2-4) of the lateral bundles fuse to form a large bundle which supplies the ovule. In certain other palms (Morrow, 1965) the ovules are supplied by several ventrally situated bundles which do not fuse but extend into the ovule.

The carpel margins (FIG. 14, centripetal to locules) are very wide. The word "margin" is arbitrarily chosen for the descriptive purposes of this paper. Whether this thick area represents wide carpel margins, Puri's "lateral face" (Puri, 1961), or a closely appressed region of the ventral surface, as would be postulated by the conduplicate concept (Swamy and Periasamy, 1964), may become clarified as more palms are studied. The single, pendulous ovule (FIG. 16) is attached near the top of the locule on one of the carpel margins. (Note the difference in the length of the slits beside the funiculus in FIGURE 13.) The attachment of the ovule between closely appressed carpel margins is unusual. With the exception of the *Cocoideae*, where the ovules are sessile, and sometimes (*Elaeis*), embedded in the ventral carpel walls, most palm ovules appear to be submarginal. A better understanding of the ovule attachment in *Aristeiera* should result from work in progress on other palm genera (Moore, 1966).

SUMMARY

1. Flowers in *Aristeiera* occur in "triads" and are deeply sunken in pits, which are regarded as invaginations of the axis.
2. The relation of the three bracteoles to the three flowers in each pit suggests that each triad represents a monochasial branching unit.
3. The vascular supplies of the three axes, each terminating in a flower, are enclosed in the axis below each pit.
4. Anatomical evidence of additional aborted flowers or branches was found on the branches terminating in each staminate flower and possibly also on the branch ending with the pistillate flower. This suggests that the *Aristeiera* triad has originated from a more ramified type of inflorescence.
5. Perianth parts of both staminate and pistillate flowers are supplied by a variable number of traces which arise in a spiral pattern as branches from bundles of the floral receptacles.

FIG. 19. Diagram showing the origin of the traces to a young pistillate flower. Details: S1 and S2, bundles to the first two sepals; third sepal of this flower received no traces. P, petal bundles; asterisks, traces to staminodes; C1, lowest carpel; C2, middle carpel; C3, upper carpel.

6. In the petals of the staminate flowers and the sepals of the pistillate flowers some of the lateral veins appear to differentiate basipetally and never become connected to the bundles of the floral receptacles.

7. Fibrous bundles having no connection to floral receptacles occur in definite patterns in perianth parts. Such bundles extend the entire length of the sepals and petals in staminate flowers, and of the sepals in pistillate flowers, but occur only in the distal, valvate part of the petals in the pistillate flowers.

8. The usual vascular supply to stamens, staminodes, and rudimentary carpels consists of one small vascular bundle.

9. The gynoecium is composed of three spirally inserted carpels. At the base they are closed and congenitally adnate to the extended central axis. In the upper part of the ovary, above the extension of the floral receptacle, the carpels are free and ventral sutures can be distinguished. Through the long stylar region, each carpel is open and connate at its margins with the other two carpels forming a 3-pronged stylar canal.

10. A single, pendulous, hemitropous, bitegmic ovule is attached to one margin of each carpel. The ovular supply is a large trace formed by the fusion of 2 or 3 bundles.

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